Life is short, science is long; opportunity is elusive, experiment is dangerous, judgment is difficult.
Hippocrates

Forum

Plant Genome

Researchers working on the plant genome project are respectful of its more celebrated sibling, the human genome project, but they also can't help being a bit envious in a good-natured sort of way. The U.S. Department of Agriculture's Plant Genome Research Program is trying to map up to 40 different genomes at a fraction of the cost it takes to map human DNA.

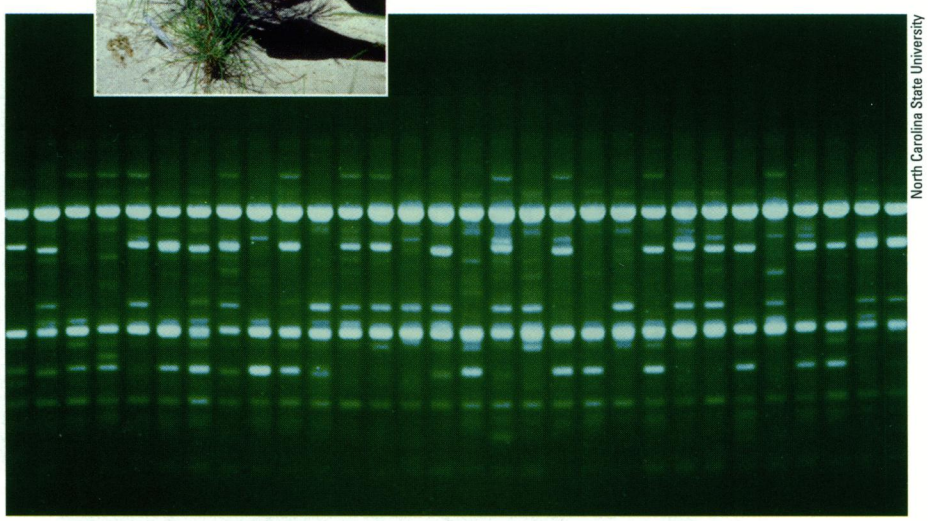
"Would that we could have their budget," said Jerry Miksche, head of the U.S. Department of Agriculture's Plant Genome Research Program. "But then, humans get cancer. Plants don't." Still, Miksche says, the efforts cooperate closely and share the latest mapping techniques and processes.

The federal agency started to develop the plant genome project in 1987, but funding wasn't approved until the 1990 farm bill passed Congress. Then, in 1991, about $14 million became available, and in 1992, another $13 million was disbursed to 97 grantees. "We really need about ten times that amount, at least $100 million for five years, to meet our goals," notes Miksche. His goal: "By 1996, I want to put genes that improve agriculture in the hands of crop breeders." That means a plethora of genetically altered food and plant products on the horizon.

What makes the program so arduous is that although scientists believe a typical plant has approximately 50,000-plus genes, fewer than a human genome, plant DNA varies widely across species, as would be expected. Different pines may share 90% of their genes, and grasses like wheat and barley may be substantially similar, but there is little genetic agreement between corn, peanuts, and cottonwood trees.

Another problem has been choosing the species to study. "If we target soybeans, then the corn people and other commodity groups go bonkers," Miksche says. The answer, so far, has been to spread funding to academic and federal researchers in 33 states. Among the states with the biggest contracts are California, Michigan, Iowa, North Carolina, Washington, and Texas.

Henry Amerson



North Carolina State University

Green genes. DNA mapping of loblolly pines may give clues to protecting forests.

Still, the fledgling program is counting some successes and a lot of enthusiasm. Efforts are underway to find markers for every million nucleotides in the genomes of dozens of major crops and trees. And the federal repository for plant genome information, the National Agricultural Library, is set to officially open soon in Beltsville, Maryland.

The University of Georgia is in the middle of a major project to map the genome of a peanut. Researchers at the University of Washington are producing what they dub "super trees." Using the information they have learned from mapping cottonwood trees, they have increased their growing time to the point that they resemble an annual harvest of plants. They hope to use the trees as a new source of fiber for pulp and paper makers and, eventually, for biofuels.

At Texas Tech University, scientists have used their own information, as well as that from the National Agricultural Library, to create new plants, such as a variety of wheat, that are able to withstand intense weather fluctuations—hot to cold and drought to flooding. Texas Tech's onions can even grow in freezing temperatures.

Perhaps one of the largest projects is the North American Barley Genome Mapping Project, involving 50 scientists in 26 university and federal laboratories in the United States and Canada. The reproductive and breeding characteristics of barley make it one of the top crop plants used for genetic map modeling. The goal is to identify as many economically important barley genes as possible and determine where they are located among the plant's seven pairs of chromosomes. This mapping will enable growers to produce better plants by manipulating genes in barley that promote high yield, malting and brewing quality, nutritional value, stress hardiness, and pest resistance.

Especially promising are efforts to find genes that will reduce the need for pesticides and fertilizers. Using a technique called mapped-based cloning, Cornell University researcher Steven Tanksley has recently located the gene that allows tomatoes to resist a common disease produced by *Pseudomonas* bacteria. The next step will be to implant that gene in plants that

cannot fight off the pathogen. Researchers at Harvard University and USDA's Agricultural Research Center are working on characterizing the complex genetic system that allows legumes such as soybeans, garden peas, and beans to help fix nitrogen in the soil. Enhancing the symbiosis between a plant and its neighboring microorganisms could reduce the need for fertilizers.

New techniques in gene mapping are making plant mapping easier. To construct genetic maps of forest trees, North Carolina State University's Forest Biotechnology Research Consortium is using a technique called random amplified polymorphic DNA (RAPD) developed by DuPont. The RAPD technology allows researchers to duplicate very short pieces of DNA from a loblolly pine, then compare genetic variations between these bits and other sections. Once hundreds of these genetic variations are plotted and their associations with other sections of DNA determined, a genetic map emerges that allows scientists to determine where genes fall in relation to markers. Ronald Sederoff, a professor of forestry and genetics, said that only a year ago mapping a loblolly pine would have taken four years and $1 million. This spring, researchers mapped it using RAPD in 60 days, at a fraction of the cost. Another technique called amplified fragment length polymorphic is also on the horizon, according to Miksche. It's much like RAPD, but even faster and more discriminating.

Efforts to map plant genomes have been aided by the agricultural industry, but their findings are often private, Miksche said. The controversy that has sprung from one of their efforts, the famous "Flavor Saver" tomato, however, portends future public debate over the safety and efficacy of genetically altered food. Miksche said he is ready for "a good public discussion," but hopes that it is "waged on scientific rather than emotional grounds."

A Healthy Peace in the Middle East

More than 50 senior scientists from academic institutions and government agencies from nine Middle East countries (Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Saudi Arabia, the United Arab Emirates, and Yemen) and from the occupied territories on the West Bank and the Gaza Strip, along with U.S. and Canadian scientists, met for the first time to address environmental health risks in the Middle East. The scientists gathered in Cairo September 6–11 to attend the Environmental Health Conference for the Middle East Region. The conference was hosted by Cairo University and sponsored by the Fogarty International Center of the National Institutes of Health, the International Development Research Centre of Canada, and NIEHS.

Terri Damstra

Middle East meets West. Participants of the conference represented Bahrain, Egypt, Gaza Strip, Israel, Jordan, Kuwait, Saudi Arabia, and the United States.

The purpose of the conference was to identify and seek possible interventions for environmental health risks that are unique to the individual countries in the Middle East or that present significantly elevated threats to occupational or environmental health. Misuse of pesticides and other agricultural chemicals, disposal of solid and chemical wastes, urban air pollution, water quality, environmental impacts of industrialization, and the adverse effects of windblown dusts and intense heat were identified as posing serious public health problems in the region. Several participants noted that infectious diseases associated with poor sanitation, food contamination, and overcrowding remain major causes of morbidity and mortality in many areas of the Middle East.

Scientists from the Middle East expressed concern and frustration about the fact that the dramatic environmental impacts of population changes and agricultural, technological, and industrial advances in the region have been identified and characterized by scientists but are apparently unrecognized by government officials and the general public. In response to this concern, participants proposed the formation of a committee of scientists who will meet regularly to address specific environmental and occupational health risks that exist in the Middle East and to develop strategies to reduce these risks.

The scientists stressed that the committee members would have the expertise to design programs that protect human health but that would not threaten the processes of economic and industrial development or the social, cultural, and religious values of the nations in the region. Because the committee includes wide regional representation, environmental concerns that affect several countries can be resolved by programs that cross national borders.

The conference took place just as the intention of the Palestinian Liberation Organization and Israel to seek a peace accord was announced. As news of the potential agreement reached Cairo, it gave added impetus to the creation of the regional committee. As one participant pointed out on the closing day of the conference, "We all come from developing countries but we are not from poor countries. We each have an obligation as scientists to convince our governmental leaders that our effort is an important part of the peace process and must be maintained as a regional effort."

Browner and Babbitt Meet the Press

EPA Administrator Carol Browner and Interior Secretary Bruce Babbitt faced tough questions on the Superfund law, the Endangered Species Act, and other issues at a meeting of environmental journalists held October 22–24.